sional space at which an array element may be present. For example, in the context of a magnetic chip of the invention, an attachment location is a site at which a localized magnetic field exists or can be generated, sufficient to cause a magnetic bead to become immobilized (trapped) with a trapping energy greater than the thermal energy of the bead.

[0038] Biocompatible: As used herein, the term biocompatible refers to a material that will not cause, catalyze, or otherwise contribute to an appreciable chemical or physical reaction that will alter the structure of a biomolecule such as a nucleic acid, protein, carbohydrate, or lipid or an intact cell or subcellular fraction, under experimental conditions and over a time scale typical of standard biological or chemical assays for interaction between molecules. In particular, the material should not damage, inhibit, or otherwise interfere with nucleic acid hybridization of with the activity enzymes typically used for molecular biology procedures such as amplification, ligation, nucleotide polymerization, etc.

[0039] Complementary: As is well known in the art, with reference to nucleic acid molecules, complementary nucleic acid molecules are able to hybridize with each other via base pairing (e.g., hydrogen bonding between A and G, between C and T, etc.). The degree and specificity of hybridization is affected by the stringency of the conditions under which the nucleic acid molecules are exposed to each other. Factors such as temperature, ionic strength of the solution, pH, presence of destabilizing agents such as formamide or stabilizing agents may all influence the degree and specificity of hybridization. Hybridization conditions are generally referred to as high, medium, or low stringency, although the meanings assigned to these terms are variable and the effect of hybridization conditions is also sequence-specific. One of ordinary skill in the art will be able to select appropriate hybridization conditions or systematically vary such conditions to perform the various assays described herein. In general, stringent conditions are selected to be approximately 5-10° C. lower than the thermal melting point (T_m) for the specific double-stranded sequence at a particular pH and ionic strength, where the T_m is the temperature at which 50% of the probes complementary to the target hybridize to the target at equilibrium, assuming targets are present in excess. Typical pH and salt concentrations for stringent conditions are approximately 0.01 to 1.0 M at pH 7.0. Information about hybridization of nucleic acids is found in Tijssen, *Techniques in Biochemistry* and *Molecular Biology—Hybridization With Nucleic Acid Probes,* Parts I and II, Elsevier Science, Ltd., 1993; Maniatis, T., Sambrook, J. and Fritsch, E., *Molecular Cloning: A Laboratory Manual* (3 Volume Set), Cold Spring Harbor Laboratory Press, Cold Spring Harbor, 1989 and its successor; and in Ausubel, et al., Current Protocols in Molecular Biology, John Wiley & Sons, New York, 2000.

[0040] In general, a nucleic acid probe for detecting a nucleic acid target is complementary to the target. However, such complementarity need not be perfect. A certain number of base pair mismatches may still allow hybridization under the stringency conditions selected. Where the nucleic acids are sufficiently complementary to allow hybridization under the selected conditions, they may be referred to as substantially complementary. For certain assays that may be employed in the context of the present invention, probes are able to distinguish between targets that differ by a single nucleotide.

[0041] Localized magnetic field: As used herein, a localized magnetic field is a magnetic field that substantially exists in the volume between the north pole of a first magnetic region and the south pole of a second magnetic region or substantially exists in the volume between the north and south poles of a single magnetic region.

[0042] Magnetic: The term magnetic, as used herein, includes ferromagnetic, paramagnetic, and superparamagnetic materials. Note that a magnetic entity need not be formed entirely of a magnetic material but may instead comprise both magnetic and nonmagnetic materials, e.g., a "magnetic bead" may comprise a nonmagnetic material with portions of magnetic material dispersed therein.

[0043] Magnetic particle: The concept of magnetic particles is discussed more fully below. It is noted that a magnetic particle can refer to any entity that includes a sufficient amount of a material that possesses magnetic properties such that the entity itself possesses magnetic properties. Magnetic materials include ferromagnetic, paramagnetic, and superparamagnetic materials and materials including such materials. In general, the term particle implies that the dimensions of the particle are small relative to dimensions of typical visible objects in the human environment. In the context of the present invention particles generally have a largest dimension of less than approximately 200 μm. Particles may have a regular shape, e.g., a substantially spherical shape, though this need not be the case. Typical magnetic particles in the context of the present invention are substantially spherical and have a diameter ranging from nanometers (e.g., 5-20 nm) to microns (e.g., 1-20 microns). However, particles with dimensions falling outside these limits may also be used.

[0044] Magnetic region or domain: This term refers to any portion of a substrate that possesses or can be modified to possess magnetic properties, or to a structure that can be applied or added to a substrate, wherein the structure possesses or can be modified to possess magnetic properties. Where the structure projects from a substrate surface, i.e., where the structure exists in three dimensions with respect to a two-dimensional surface, the structure may be referred to as a magnetic island. In general, a magnetic region or domain will contain a magnetic or magnetizable material such as iron, cobalt, nickel, or certain ceramics. The substrate itself may also possess magnetic properties although, in general this is not the case for the particular embodiments of the invention described in detail herein. Note that a magnetic region may exist in a magnetized or demagnetized state.

[0045] Population: As used herein, a population refers to a group of entities that are similar with respect to some significant feature. For example, a population of beads may be similar in that beads in the population